Claims

1. A process for increasing the molecular weight and/or for the modification of a polycondensate, which process comprises adding to the polycondensate

a) at least one bis-acyllactam;

b1) at least one phosphite, phosphinate or phosphonate; or

b2) at least one benzofuran-2-one type compound or

b3) at least one phosphite, phosphinate or phosphonate and one benzofuran-2-one type compound

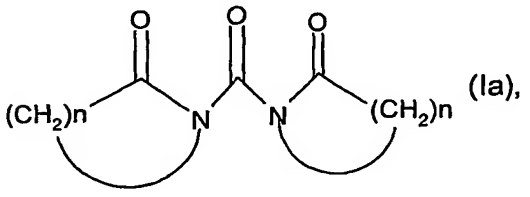
and processing the mixture in the melt.

2. A process according to claim 1 wherein the polycondensate is an aliphatic or aromatic polyester, an aliphatic or aromatic polyamide or polycarbonate, or a blend or copolymer thereof.

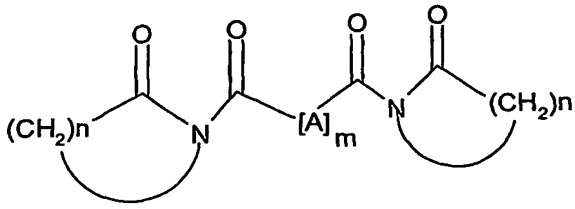
3. A process according to claim 1 wherein the polycondensate is polyethylene therephthalate (PET), polybutylene therephthalate (PBT), polyethylenenaphthenate (PEN), a copolyester, PA 6, PA 6,6, a polycarbonate containing bisphenol A, bisphenol Z or bisphenol F linked via carbonate groups.

4. A process according to claim 1 wherein the polycondensate is PET or PBT or a copolymer of PET or PBT.

5. A process according to claim 1 wherein the bis-acyllactam is of formula Ia or Ib



(Ia),



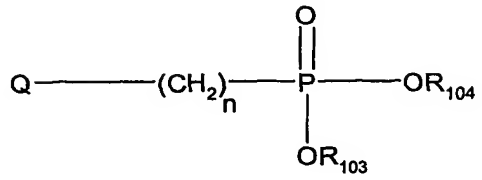
(Ib)

wherein A is C_1-C_{18}alkylen, C_2-C_{18}alkylene interrupted by at least one oxygen atom, C_1-C_{18}alkenylene, phenylene, phenylene-C_1-C_{18}alkylene, C_1-C_{18}alkylene-phenylene, or C_1-C_{18}alkylene-phenylene-C_1-C_{18}alkylene;

m is 0 or 1 and

n is a number from 3 to 12.

6. A process according to claim 1 wherein the phosphonate is of formula II



(II) , wherein

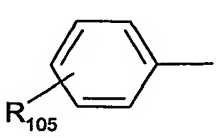
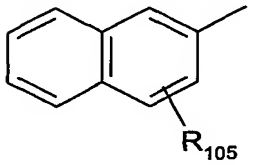
R_{103} is H, C_1-C_{20}alkyl, unsubstituted or C_1-C_4alkyl-substituted phenyl or naphthyl,

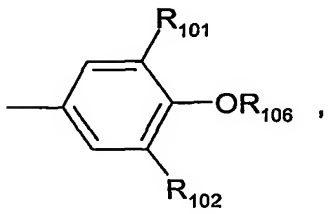
R_{104} is hydrogen, C_1-C_{20}alkyl, unsubstituted or C_1-C_4alkyl-substituted phenyl or naphthyl; or M^{r+} / r,

M^{r+} is an r-valent metal cation or the ammonium ion,

n is 0, 1, 2, 3, 4, 5 or 6, and

r is 1, 2, 3 or 4;

Q is hydrogen, -X-C(O)-OR_{107}, or a radical  ,  ,

 ,

R_{101} is isopropyl, tert-butyl, cyclohexyl, or cyclohexyl which is substituted by 1-3 C_1-C_4alkyl groups,

R_{102} is hydrogen, C_1-C_4alkyl, cyclohexyl, or cyclohexyl which is substituted by 1-3 C_1-C_4alkyl groups,

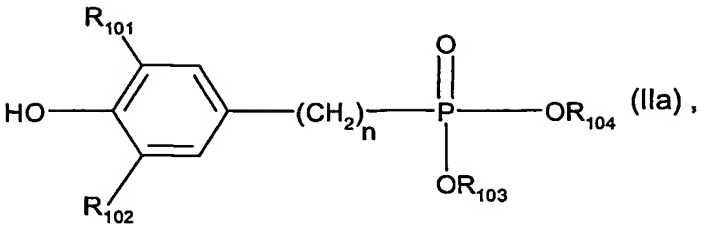
R_{105} is H, C_1-C_{18}alkyl, OH, halogen or C_3-C_7cycloalkyl;

R_{106} is H, methyl, trimethylsilyl, benzyl, phenyl, sulfonyl or C_1-C_{18}alkyl;

R_{107} is H, C_1-C_{10}alkyl or C_3-C_7cycloalkyl; and

X is phenylene, C_1-C_4alkyl group-substituted phenylene or cyclohexylene.

7. A process according to claim 6 wherein the phosphonate is of formula IIa



(IIa),

wherein

R_{101} is H, isopropyl, tert-butyl, cyclohexyl, or cyclohexyl which is substituted by 1-3 C_1-C_4alkyl groups,

R_{102} is hydrogen, C_1-C_4alkyl, cyclohexyl, or cyclohexyl which is substituted by 1-3 C_1-C_4alkyl groups,

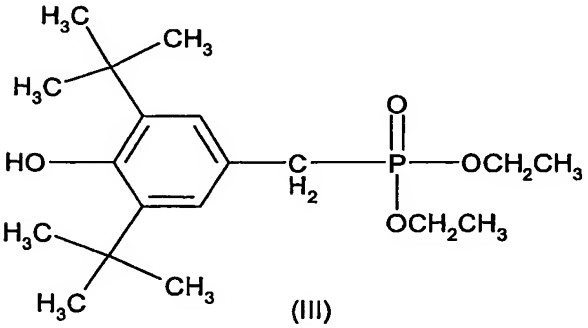
R_{103} is C_1-C_{20}alkyl, unsubstituted or C_1-C_4alkyl-substituted phenyl or naphthyl,

R_{104} is hydrogen, C_1-C_{20}alkyl, unsubstituted or C_1-C_4alkyl-substituted phenyl or naphthyl; or M^{r+} / r;

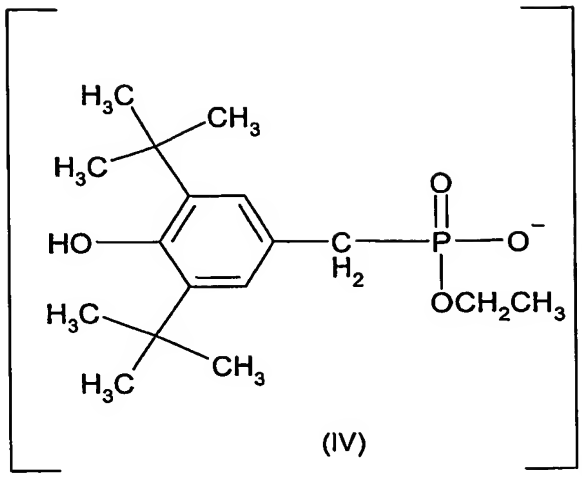
M^{r+} is an r-valent metal cation, r is 1, 2, 3 or 4; and

n is 1, 2, 3, 4, 5 or 6.

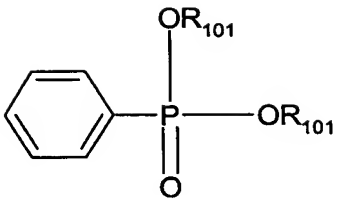
8. A process according to claim 1 wherein the phosphonate is of formula III, IV, V, VI or VII



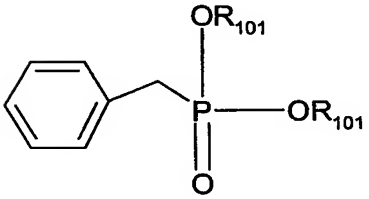
(III)



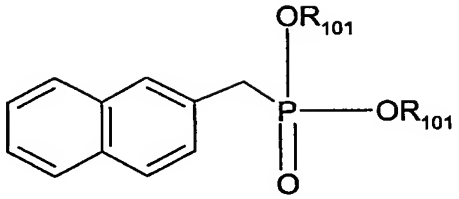
(IV)



(V)



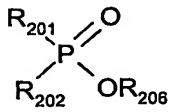
(VI),



(VII),

wherein the R_{101} are each independently of one another hydrogen or M^{n+} / r.;

9. A process according to claim 1 wherein the phosphinates are of the formula XX

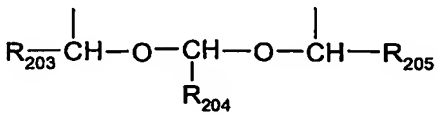


(XX)

wherein

R_{201} is hydrogen, C_1-C_{20}alkyl, phenyl or C_1-C_4alkyl substituted phenyl; biphenyl, naphthyl, -CH_2-O-C_1-C_{20}alkyl or -CH_2-S-C_1-C_{20}alkyl,

R_{202} is C_1-C_{20}alkyl, phenyl or C_1-C_4alkyl substituted phenyl; biphenyl, naphthyl, -CH_2-O-C_1-C_{20}alkyl or -CH_2-S-C_1-C_{20}alkyl, or R_1 and R_2 together are a radical of the formula XXI



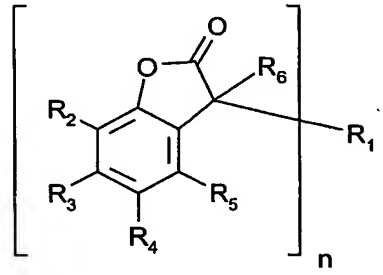
(XXI)

wherein

R_{203}, R_{204} and R_{205} independently of each other are C_1-C_{20}alkyl, phenyl or C_1-C_4alkyl substituted phenyl;

R_{206} is hydrogen, C_1-C_{18}alkyl or the ion of an alkali metal or the ammonium ion or R_{206} is a direct bond, which forms together with R_{202} an aliphatic or aromatic cyclic ester.

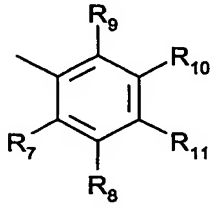
10. A process according to claim 1 wherein the benzofuran-2-one type compound is of formula X



(X)

wherein, if n = 1,

R_1 is naphthyl, phenanthryl, anthryl, 5,6,7,8-tetrahydro-2-naphthyl, 5,6,7,8-tetrahydro-1-naphthyl, thienyl, benzo[b]thienyl, naphtho[2,3-b]thienyl, thianthrenyl, dibenzofuryl, chromenyl, xanthenyl, phenoxathiinyl, pyrrolyl, imidazolyl, pyrazolyl, pyrazinyl, pyrimidinyl, pyridazinyl, indolizinyl, isoindolyl, indolyl, indazolyl, purinyl, quinolizinyl, isoquinolyl, quinolyl, phthalazinyl, naphthyridinyl, quinoxalinyl, quinazolinyl, cinnolinyl, pteridinyl, carbazolyl, β-carbolinyl, phenanthridinyl, acridinyl, perimidinyl, phenanthrolinyl, phenazinyl, isothiazolyl, phenothiazinyl, isoxazolyl, furazanyl, biphenyl, terphenyl, fluorenyl or phenoxazinyl, each of which is unsubstituted or substituted by C_1-C_4alkyl, C_1-C_4alkoxy, C_1-C_4alkylthio, hydroxy, halogen, amino, C_1-C_4alkylamino, phenylamino or di(C_1-C_4-alkyl)amino, or R_1 is a radical of formula XI

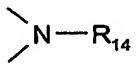


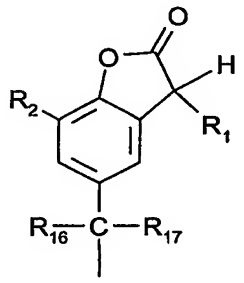
(XI),

and,

if n = 2,

R_1 is unsubstituted or C_1-C_4alkyl- or hydroxy-substituted phenylene or naphthylene; or $-R_{12}-X-R_{13}-$,

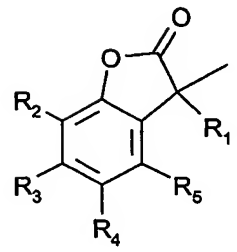
R_2, R_3, R_4 and R_5 are each independently of one another hydrogen, chloro, hydroxy, C_1-C_{25}-alkyl, C_7-C_9phenylalkyl, unsubstituted or C_1-C_4alkyl-substituted phenyl; unsubstituted or C_1-C_4alkyl-substituted C_5-C_8cycloalkyl; C_1-C_{18}alkoxy, C_1-C_{18}alkylthio, C_1-C_4alkylamino, di(C_1-C_4-alkyl)amino, C_1-C_{25}alkanoyloxy, C_1-C_{25}alkanoylamino, C_3-C_{25}alkenoyloxy; C_3-C_{25}alkanoyloxy which is interrupted by oxygen, sulfur or  ; C_6-C_9cycloalkylcarbonyloxy, benzoyloxy or C_1-C_{12}alkyl-substituted benzoyloxy; or R_2 and R_3, or R_3 and R_4, or R_4 and R_5, together with the linking carbon atoms, form a benzene ring, R_4 is additionally $-(CH_2)_p-COR_{15}$ or $-(CH_2)_qOH$ or, if R_3, R_5 and R_6 are hydrogen, R_4 is additionally a radical of formula XII



(XII),

wherein R_1 is as defined above for n = 1,

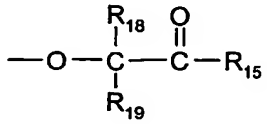
R_6 is hydrogen or a radical of formula XIII



(XIII),

wherein R_4 is not a radical of formula XII, and R_1 is as defined above for n = 1,

R_7, R_8, R_9, R_{10} and R_{11} are each independently of one another hydrogen, halogen, hydroxy, C_1-C_{25}alkyl; C_2-C_{25}alkyl which is interrupted by oxygen, sulfur or $>N-R_{14}$; C_1-C_{25}alkoxy; C_2-C_{25}alkoxy which is interrupted by oxygen, sulfur or $>N-R_{14}$; C_1-C_{25}alkylthio, C_3-C_{25}-alkenyl, C_3-C_{25}alkenyloxy, C_3-C_{25}alkynyl, C_3-C_{25}alkynyloxy, C_7-C_9phenylalkyl, C_7-C_9phenyl-alkoxy, unsubstituted or C_1-C_4alkyl-substituted phenyl; unsubstituted or C_1-C_4alkyl-substituted phenoxy; unsubstituted or C_1-C_4alkyl-substituted C_5-C_8cycloalkyl; unsubstituted or C_1-C_4alkyl-substituted C_5-C_8cycloalkoxy; C_1-C_4alkylamino, di(C_1-C_4alkyl)amino, C_1-C_{25}alkanoyl; C_3-C_{25}alkanoyl which is interrupted by oxygen, sulfur or $>N-R_{14}$; C_1-C_{25}alkanoyloxy; C_3-C_{25}alkanoyloxy which is interrupted by oxygen, sulfur or $>N-R_{14}$; C_1-C_{25}alkanoylamino, C_3-C_{25}alkenoyl; C_3-C_{25}alkenoyl which is interrupted by oxygen, sulfur or $>N-R_{14}$; C_3-C_{25}alkenoyloxy; C_3-C_{25}alkenoyloxy which is interrupted by oxygen, sulfur or $>N-R_{14}$; C_6-C_9cycloalkylcarbonyl, C_6-C_9cycloalkylcarbonyloxy, benzoyl or C_1-C_{12}alkyl-substituted benzoyl; benzoyloxy or C_1-C_{12}alkyl-substituted benzoyloxy;



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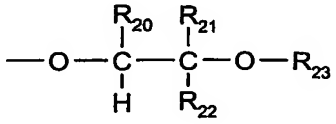
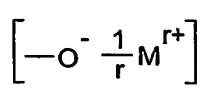
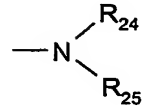


or, in formula II, R_7 and R_8, or R_8 and R_{11}, together with the linking carbon atoms, form a benzene ring,

R_{12} and R_{13} are each independently of the other unsubstituted or C_1-C_4alkyl-substituted phenylene or naphthylene,

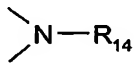
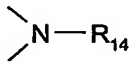
R_{14} is hydrogen or C_1-C_8alkyl,

R_{15} is hydroxy,  , C_1-C_{18}alkoxy or  ,

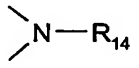
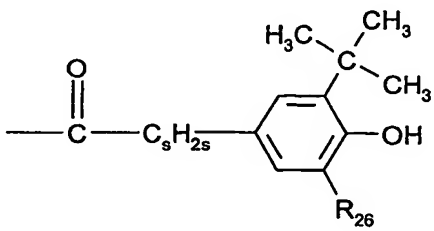
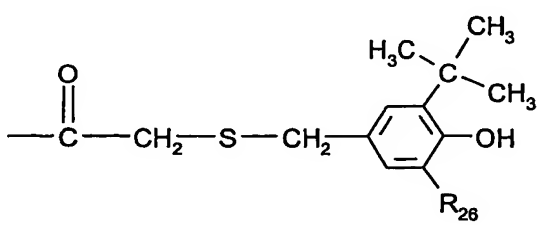
R_{16} and R_{17} are each independently of the other hydrogen, CF_3, C_1-C_{12}alkyl or phenyl, or R_{16} and R_{17}, together with the linking carbon atom, are a C_5-C_8cycloalkylidene ring which is unsubstituted or substituted by 1 to 3 C_1-C_4alkyl;

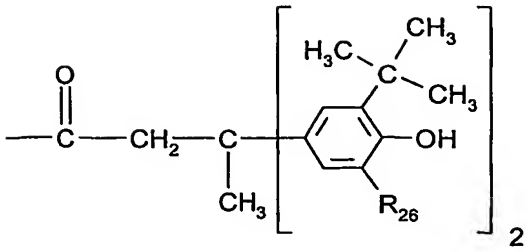
R_{18} and R_{19} are each independently of the other hydrogen, C_1-C_4alkyl or phenyl,

R_{20} is hydrogen or C_1-C_4alkyl,

R_{21} is hydrogen, unsubstituted or C_1-C_4alkyl-substituted phenyl; C_1-C_{25}alkyl; C_2-C_{25}alkyl which is interrupted by oxygen, sulfur or  ; C_7-C_9phenylalkyl which is unsubstituted or substituted at the phenyl moiety by 1 to 3 C_1-C_4alkyl; C_7-C_{25}phenylalkyl which is interrupted by oxygen, sulfur or  and which is unsubstituted or substituted at the phenyl moiety by 1 to 3 C_1-C_4alkyl, or R_{20} and R_{21}, together with the linking carbon atoms, form a C_5-C_{12}cycloalkylene ring which is unsubstituted or substituted by 1 to 3 C_1-C_4alkyl;

R_{22} is hydrogen or C_1-C_4alkyl,

R_{23} is hydrogen, C_1-C_{25}alkanoyl, C_3-C_{25}alkenoyl; C_3-C_{25}alkanoyl which is interrupted by oxygen, sulfur or  ; C_2-C_{25}alkanoyl which is substituted by a di(C_1-C_6alkyl)phosphonate group; C_6-C_9cycloalkylcarbonyl, thenoyl, furoyl, benzoyl or C_1-C_{12}alkyl-substituted benzoyl;  ,  ,



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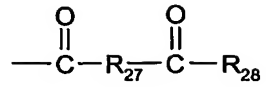

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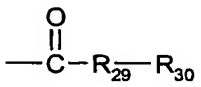
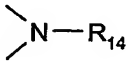
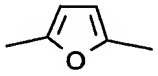
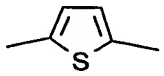
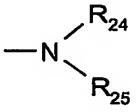


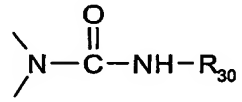
,

R_{24} and R_{25} are each independently of the other hydrogen or C_1-C_{18}alkyl,

R_{26} is hydrogen or C_1-C_8alkyl,

R_{27} is a direct bond, C_1-C_{18}alkylene; C_2-C_{18}alkylene which is interrupted by oxygen, sulfur or  ; C_2-C_{18}alkenylene, C_2-C_{20}alkylidene, C_7-C_{20}phenylalkylidene, C_5-C_8cycloalkylene, C_7-C_8bicycloalkylene, unsubstituted or C_1-C_4alkyl-substituted phenylene,  or  ,

R_{28} is hydroxy, , C_1-C_{18}alkoxy or  ,

R_{29} is oxygen, -NH- or  ,

R_{30} is C_1-C_{18}alkyl or phenyl,

R_{31} is hydrogen or C_1-C_{18}alkyl,

M is an r-valent metal cation,

X is a direct bond, oxygen, sulfur or -NR_{31}- ,

n is 1 or 2,

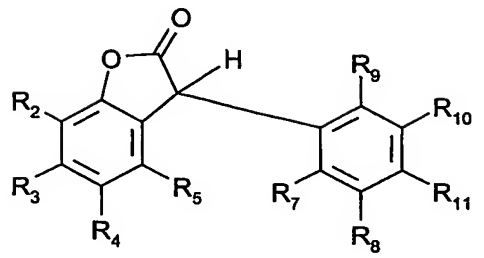
p is 0, 1 or 2,

q is 1, 2, 3, 4, 5 or 6,

r is 1, 2 or 3, and

s is 0, 1 or 2.

11. A process according to claim 10 wherein the benzofuran-2-one type compound is of formula XIV



(XIV)

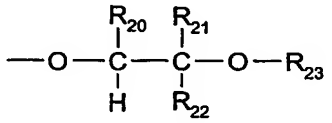
wherein

R_2 is hydrogen or C_1-C_6alkyl,

R_3 is hydrogen,

R_4 is hydrogen or C_1-C_6alkyl,

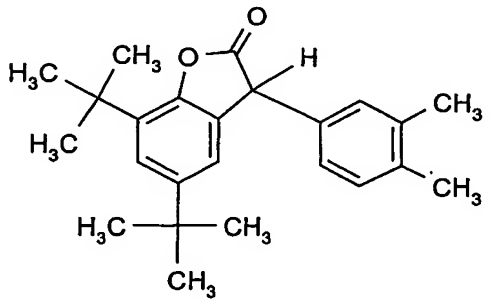
R_5 is hydrogen,

R_7, R_8, R_9, R_{10} and R_{11} are each independently of one another hydrogen, C_1-C_4alkyl, C_1-C_4-alkoxy or  , with the proviso that at least two of R_7, R_8, R_9, R_{10} or R_{11} are hydrogen,

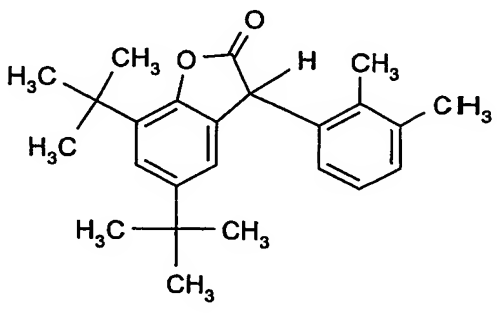
R_{20}, R_{21} and R_{23} are hydrogen, and

R_{23} is C_2-C_4alkanoyl.

12. A process according to claim 11 wherein the benzofuran-2-one type compound is of formula XIVa or XIVb



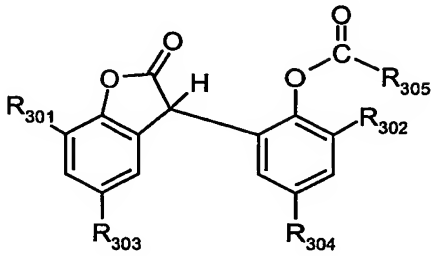
(XIVa)



(XIVb)

or a mixture or blend of the two compounds of formulae XIVa and XIVb.

13. A process according to claim 1 wherein the benzofuran-2-one type compound is of formula XV



(XV)

wherein

R_{301} and R_{302} are each independently of one another hydrogen or C_1-C_8alkyl,

R_{303} and R_{304} are each independently of one another C_1-C_{12}alkyl, and

R_{305} is C_1-C_7alkyl.

14. A process according to claim 1 wherein the bis-acyllactam is used in an amount of 0.01 to 5 % by weight based on the weight of the polycondensate.

15. A process according to claim 1 wherein the phosphite, phosphinate or phosphonate is used in an amount of 0.01 to 5 % by weight based on the weight of the polycondensate.

16. A process according to claim 1 wherein the benzofuran-2-one type compound is used in an amount of 0.01 to 5 % by weight based on the weight of the polycondensate.

17. A process according to claim 1 wherein the ratio of the bis-acyllactam to the phosphite, phosphinate, phosphonate or to the benzofuran-2-one type compound or the sum of all is from 1:10 to 5:1.

18. A process according to claim 1 wherein the maximum mass-temperature of the melt is from 170° to 320° C.

19. A process according to claim 1 wherein an oxazoline compound is additionally present.

20. A composition comprising

a) a polycondensate;

b) at least one bis-acyllactam;

c1) at least one phosphite, phosphinate or phosphonate; or

c2) at least one benzofuran-2-one type compound or

c3) at least one phosphite, phosphinate or phosphonate and one benzofuran-2-one type compound.

21. A polycondensate obtainable by a process according to claim 1.

22. Use of a mixture of

a) at least one bis-acyllactam;

b1) at least one phosphite, phosphinate or phosphonate; or

b2) at least one benzofuran-2-one type compound or

b3) at least one phosphite, phosphinate or phosphonate and one benzofuran-2-one type compound

for increasing the molecular weight, for the modification and/or for reducing yellowing of a polycondensate.